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HARMONIZATION OF CUSTOMS PROCEDURS IN THE INTERACTION OF TRANSPORT MODES AS A FACTOR FOR ENHANCING THE EFFICIENCY OF MULTIMODAL LOGISTICS CHAINS

Viktoriia Klymenko, Larysa Dokiienko, Nadiia Novalska, Olena Sokolova. "Harmonization of Customs Procedurs in the Interaction of Transport Modes as a Factor for Enhancing the Efficiency of Multimodal Logistics Chains". *Conceptual approaches to organizing the customs clearance of goods transported along a multimodal route have been defined in the paper. The purpose of the research is to analyze*

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the current state of organizing and conducting customs operations in Ukraine, identify bottlenecks in customs service, substantiate the specifics of performing customs operations in multimodal transport, and develop recommendations for their unification. The article examines the current state of the organization of customs operations in Ukraine, which is characterized by increased transparency and the active implementation of digital tools. It is proven that the implementation of the Authorized Economic Operator (AEO) institution and the successful application of the NCTS technology have become key steps in integrating the domestic customs system with the European one. At the same time, emphasis is placed on the need for further deep unification of customs procedures to ensure the efficient operation of multimodal transport networks. To achieve continuity in the multimodal supply chain, it is proposed to carry out regulatory and procedural integration through the implementation of a global electronic document and an end-to-end AEO status, as well as to interconnect databases using artificial intelligence and blockchain. The infrastructural basis for such innovations should be the development of a network of modern multimodal terminals and "dry ports" functioning as customs hubs. Measures are proposed to unify customs operations during the interaction of transport modes in multimodal traffic, which will help eliminate barriers and duplication, as well as reduce transshipment time at transport hubs.

***Keywords**:* customs, transport, multimodal system, logistics, "customs visa-free regime"

Вікторія Клименко, Лариса Докієнко, Надія Новальська, Олена Соколова. «Уніфікація митних процедур при взаємодії видів транспорту як чинник підвищення ефективності мультимодальних логістичних ланцюгів». *У статті визначено концептуальні підходи до організації митного оформлення вантажів, що перевозяться за мультимодальним маршрутом. Метою статті є аналіз сучасного стану організації і проведення митних операцій в Україні, виявлення «вузьких місць» у митному обслуговуванні, обґрунтування особливостей виконання митних операцій у мультимодальному сполученні та розробка рекомендацій щодо їх уніфікації. У статті досліджено сучасний стан організації митних операцій в Україні, який характеризується підвищенням прозорості та активним впровадженням цифрових інструментів. Доведено, що імплементація інституту Авторизованого економічного оператора (АЕО) та успішне застосування технології NCTS стали ключовими кроками інтеграції вітчизняної митної системи з європейською. Водночас акцентовано увагу на необхідності подальшої глибокої уніфікації митних процедур для забезпечення ефективної роботи мультимодальних транспортних мереж. Для досягнення безперервності мультимодального ланцюга постачання запропоновано здійснити нормативно-процедурну інтеграцію через впровадження глобального електронного документа й наскрізного статусу АЕО, а також об'єднати бази даних за допомогою штучного інтелекту та блокчейну. Інфраструктурною основою таких інновацій має стати розбудова мережі сучасних мультимодальних терміналів і «сухих портів» із функціями митних хабів. Запропоновано заходи щодо уніфікації митних операцій при взаємодії видів транспорту у мультимодальному сполученні, що сприятиме усуненню бар'єрів і дублювання та зменшить час перевалки у транспортних вузлах.*

Ключові слова: митниця, транспорт, мультимодальна система, логістика, «митний безвіз»

Introduction. Export-import and transit transportation require the mandatory implementation of customs procedures, which include customs control, clearance, declaration and taxation of both goods and vehicles [1].

Currently, international transportation occupies a significant share in the total cargo turnover of Ukraine, which is explained by the export orientation of Ukraine and the decline in domestic consumption due to the military aggression of the russian federation against

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Ukraine. The total share of a certain mode of transport in exports, imports and transit ranges from 50-60% for road and rail to 100% for sea. All international transportation is carried out with border crossing and customs procedures. And although each mode of transport is regulated by its own international regulations, customs is the only body that must work effectively for any vehicle. Technological customs control schemes used for each mode of transport have their own characteristics [2]. The most complex are schemes that involve the interaction of transport modes.

And although during 2022-2025 a great step was taken towards simplifying and automating customs procedures, a number of problems related to the organization of the movement of goods by various modes of transport across the customs border of Ukraine remain. Therefore, studying the issues of unification of customs procedures in interaction of transport modes is relevant both from the point of view of theory and economic practice.

Analysis of recent studies and publications. The study of the problems of customs procedures during the transportation of goods is devoted to publications on both logistics and international law, management of foreign economic activity and public administration.

Thus, in paper [3] the issue of digitalization of customs control during the transportation of goods by rail is considered. The authors note that the use of the latest digital technologies in the process of customs control of cargo transportation is aimed at minimizing time and financial costs when passing customs procedures. In the paper [4] the authors draw attention to the need to improve the procedures for customs control and the process of registration of international cargo transportation by applying innovative approaches. In particular, they are talking about the integration of artificial intelligence technologies for automating work processes.

The relevance of further development of freight rail logistics in Ukraine under modern economic conditions is considered in the work [5]. In their study, the authors emphasize that bureaucratic procedures, like the duplication of functions of controlling customs services, are logistical restrictions on exports at the western border.

Legal aspects of customs clearance are studied in the research [6]. The authors note that improving the customs control system requires an understanding of the basic principles and legal nature of customs formalities. Only under such conditions will reforms be consistent, justified and effective.

The paper [7] studies the issue of interaction of transport modes in the system of international transport corridors passing through the territory of Ukraine. It also considers the issue of harmonization of customs procedures and the customs transit mechanism with generally accepted norms and standards of European Union law.

Identification of previously unresolved parts of the overall problem.

At the same time, it should be noted that the problems of unification of customs procedures in multimodal chains, in particular ensuring their clarity, transparency and digitalization, taking into account the technical and technological features of each interacting mode of transport, have received insufficient attention from the scientific community, which determined the purpose and objectives of this article.

Formulation of the article's objectives. The purpose of the study is to develop proposals for the optimization of customs procedures in multimodal logistics chains. The objectives of the article are:

- analysis of the current state of the organization and execution of customs procedures in Ukraine;
- study of border crossing indicators for various modes of freight transport across specific sections of the state border of Ukraine;

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- assessment of the level of implementation of the common transit procedure;
- identification of "bottlenecks" in customs service;
- justification of the features of customs procedures in multimodal logistics chains and development of recommendations for their unification.

Research Methods. The methodological framework of the study is based on systems approach according to which customs procedures were considered as a element of unified system "transport-customs-multimodal terminal". Logical generalization and critical review were used for assessing the experience of AEO and NTCS in Ukraine and identifying the "bottlenecks" in customs service of multimodal logistics chains. To develop concept of future customs support for transport modes interaction, method of conceptual modeling was applied.

The research is based on the generalization of scientific publications, regulatory framework on customs, official documents of State Customs Service of Ukraine and State Statistics Service of Ukraine, as well as international organizations.

The conclusions obtained can be used to improve customs procedures in multimodal logistics chains and increase the efficiency of their operation.

Presentation of the main research material. The state of the organization of customs procedures in Ukraine is evidenced by such an international indicator as the Logistics Performance Index (LPI), one of the components of which is the customs service indicator. Table 1 presents the dynamics of the LPI and its components for the period from 2007 to 2023.

Table 1. Dynamics of the Components of the Logistics Performance Index (LPI) for Ukraine

Indicator	2007	2010	2012	2014	2016	2018	2023
Logistics Performance Index, points	2.55	2.57	2.85	2.98	2.74	2.83	2.7
LPI components:							
customs	2.22	2.02	2.41	2.69	2.30	2.49	2.4
infrastructure	2.35	2.44	2.69	2.65	2.49	2.22	2.4
international shipments	2.53	2.79	2.72	2.95	2.59	2.83	2.8
service quality	2.41	2.59	2.85	2.84	2.55	2.84	2.6
tracking and tracing	2.53	2.49	3.15	3.20	2.96	3.11	3.1
timeliness	3.31	3.06	3.31	3.51	3.51	3.42	2.6

Source: Developed by the authors based on [8].

As can be seen from the data in Table 2, for the analyzed period, the LPI ranged from 2.55 in 2007 to 2.98 in 2014, in 2023 its value is 2.7 (with a maximum possible 5 points according to the calculation method). The lowest value of the LPI components is the customs service indicator, which for 2027-2023 ranged from 2.02 to 2.69. Currently, it is 2.4 points.

The assessment of the overall level of implementation of measures on customs services and trade facilitation is also carried out within the framework of the UN global survey on digital and sustainable trade facilitation, according to which this indicator in Ukraine is 60.22% (Fig. 1).

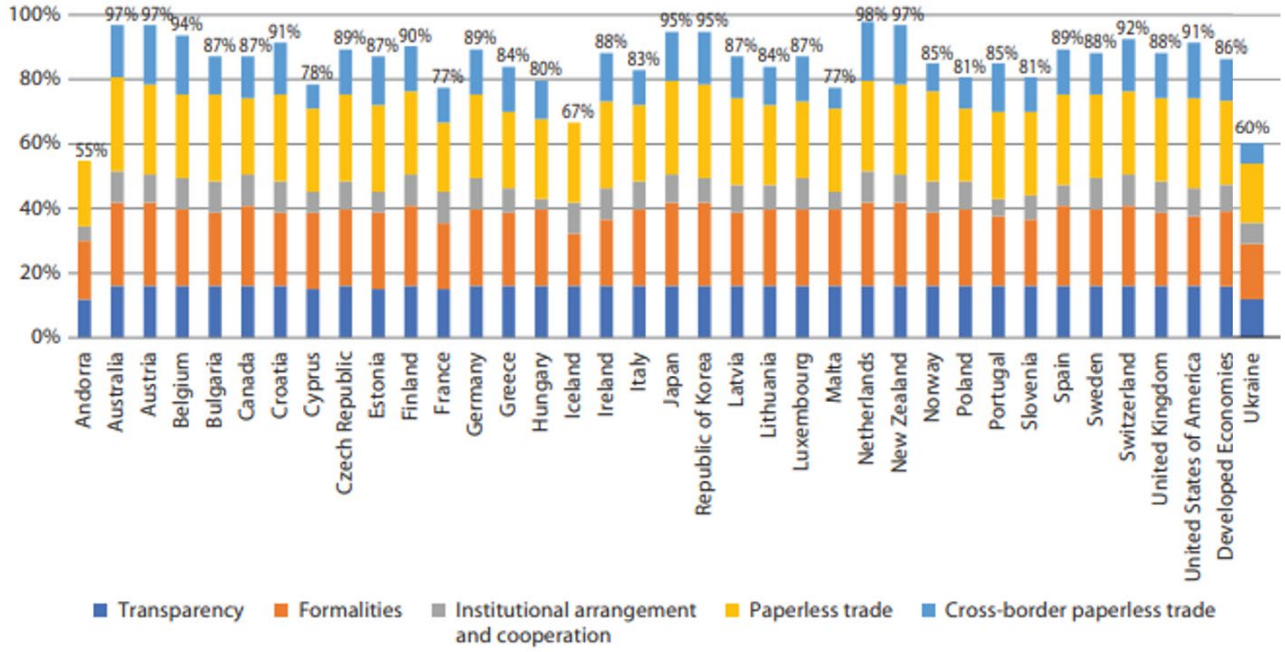

Figure 1 – Average Implementation Rates of Trade Facilitation Measures in Developed Economies and Ukraine
Source: compiled by the authors based on [9]

The key components of the Trade Facilitation Index, presented in Fig. 1, include:

- transparency – 73.33%, which indicates Ukraine's successful implementation of basic requirements for informing businesses, in particular: open publication of rules and tariffs, availability of contact centers for inquiries, mechanism for providing advance rulings on classification of goods and origin (the highest indicator for Ukraine);

- formalities – 66.67%, which assesses the improvement of physical and administrative customs clearance in Ukraine through the application of a risk management system, implementation of mechanisms for accelerated clearance of perishable goods and express shipments, and customs audits after the release of goods;

- institutional arrangements and cooperation – 66.67%, which reflects the level of coordination between government agencies. In this direction, the functioning of the National Committee for Trade Facilitation in Ukraine, coordination between customs and other regulatory authorities, in particular phytosanitary, veterinary, etc., is positive;

- paperless trade – 62.96%, which shows the level of use of internal digitalization of trade and customs processes. Ukraine has implemented such digital tools as: submission of customs declarations in electronic form, electronic customs payments, use of the Single Window system for interaction between importers/exporters and state authorities;

- cross-border paperless trade – 33.33%, which assesses the possibility of exchanging electronic data with partner countries at the global level, as well as cross-border recognition of electronic signatures. This is the lowest indicator, which remains a "bottleneck" for Ukraine [10].

The importance and necessity of improving customs services in Ukraine is determined by its transit potential, the volume of international transportation, and the number of crossings of the state border by freight transport (Fig. 2).

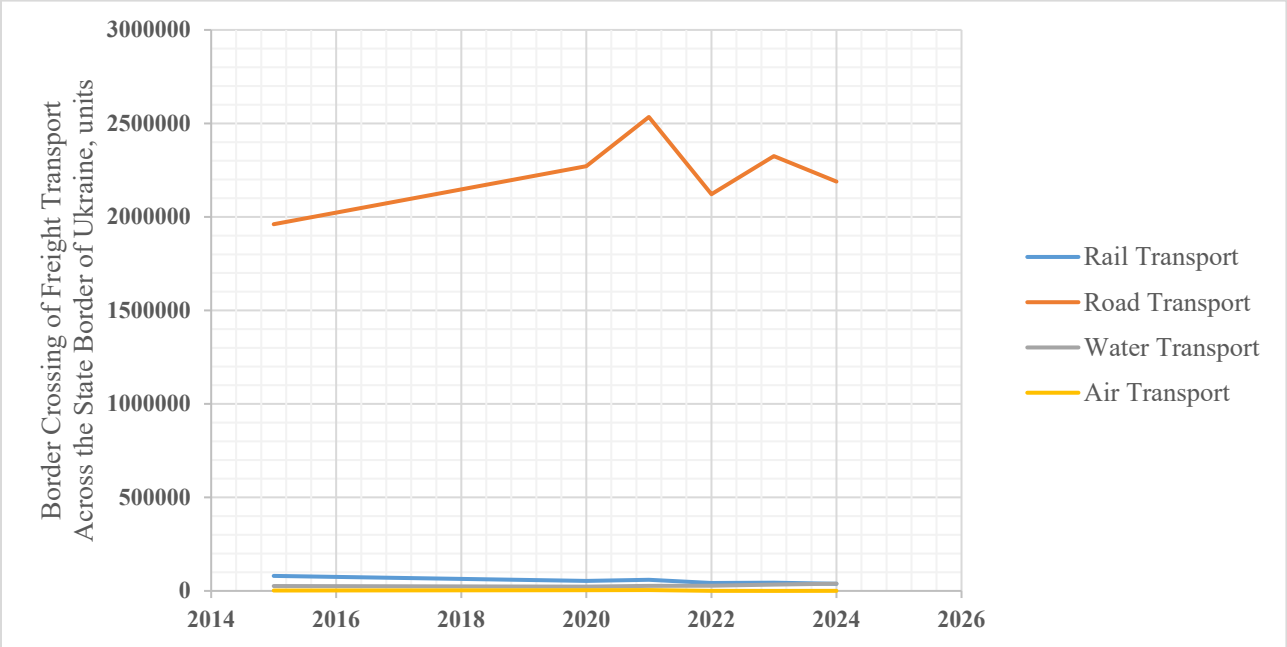

Figure 2 – Border Crossing of Freight Transport Across the State Border of Ukraine by Modes of Transport, units

Source: Developed by the authors based on [11]

Fig. 2 shows the dynamics of freight transport across the state border of Ukraine by mode of transport. Analysis of the structure of transportation for the period 2012-2024 (Table 2) allows us to assess the role of each mode of transport in ensuring the state's foreign economic relations.

In the regional context and by individual modes of transport, the structure of cargo units crossing the customs border of Ukraine has significant differences (Table 2). Thus, the largest share of cargo transportation is carried out by rail through customs checkpoints on the Ukrainian-Polish section of the border. During the analyzed period, the number of rail transport units crossing the border on the specified section increased from 7,788 units in 2020 to 16,041 units in 2024 (or 2.06 times). The same significantly increasing dynamics is observed on the Ukrainian-Romanian border section (an increase in the number of rail transport units by 1.6 times).

Considering the road mode of transport, similar vectors of change were identified. In particular, the share of customs checkpoints located on the Ukrainian-Romanian border in the total volume of customs services for road vehicles increased from 7.6% in 2020 to 20.9% in 2024. The number of road transport units crossing the border on the specified section increased by 2.65 times over the analyzed period.

The improvement of the situation with customs clearance of goods and transport at the state border of Ukraine was facilitated by the introduction of the institution of Authorized Economic Operator (hereinafter – AEO) in 2019.

Obtaining AEO status by economic entities allows them to enjoy special customs benefits and simplifications.

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Table 2 – Border Crossing of Freight Transport Across the State Border of Ukraine

Mode of Transport	Sections of the State Border	2020		2021		2022		2023		2024	
		units	structura, %	units	structura, %	units	structura, %	units	structura, %	units	structura, %
Rail	Total	53149	100	59472	100	41992	100	44155	100	38060	100
	Polish	7788	14.7	10512	17.7	13252	31.6	14138	32.0	16041	42.1
	Slovak	9021	17.0	10906	18.3	10565	25.2	11140	25.2	9369	24.6
	Hungarian	4075	7.7	3761	6.3	4525	10.8	5664	12.8	3818	10.0
	Romanian	3387	6.4	3850	6.5	4997	11.9	5424	12.3	5271	13.8
	Moldovan	4405	8.3	4624	7.8	5724	13.6	7789	17.6	3561	9.4
Road	Total	2271472	100	2534363	100	2121886	100	2324791	100	2189157	100
	Polish	813175	35.8	929902	36.7	1046598	49.3	1255859	54.0	1087963	49.7
	Slovak	86431	3.8	84067	3.3	90719	4.3	113720	4.9	112501	5.1
	Hungarian	165431	7.3	174856	6.9	179795	8.5	189151	8.1	183565	8.4
	Romanian	172723	7.6	194506	7.7	368757	17.4	430111	18.5	457036	20.9
	Moldovan	356456	15.7	416397	16.4	350672	16.5	335950	14.5	348092	15.9
Water	Total	22892	100	27330	100	27882	100	34038	100	38757	100
	Romanian	1170	5.1	4766	17.4	6588	23.6	6512	19.1	19961	51.5
	Maritime	21720	94.9	22546	82.5	21294	76.4	27526	80.9	18796	48.5
Air	Total	3453	100	4506	100	676	100	16	100	56	100

Source: Developed by the authors based on [11]

According to the Customs Code of Ukraine, AEO status can be acquired by a resident enterprise that performs any role in the international supply chain of goods (manufacturer, exporter, importer, customs representative, carrier, forwarder, warehouse keeper), which:

1) complies with the requirements of customs and tax legislation, has not been held criminally liable;

2) demonstrates a high level of control over operations and commodity flows;

3) has a stable financial position;

4) ensures practical standards of competence or professional qualifications of the responsible official of the enterprise;

5) complies with safety and reliability standards.

Moreover, authorization can be of two types:

1) granting the right to apply simplifications (AEO-C);

2) confirming safety and reliability (AEO-B) [1].

The challenges that Ukraine's transport system faced due to the russian federation's military aggression became a catalyst for transformations in the customs sector. Ukraine joined the Convention on the Common Transit Procedure [12], and from October 1, 2022, domestic business received the right to the simplification and benefits of this procedure. The Convention is designed to simplify international trade processes by providing a simple and transparent transit procedure based on the formula: "one means of transport – one declaration – one

guarantee". This means that several shipments that are grouped together, loaded onto one means of transport (in a container or packaging) and shipped as consolidated cargo within the framework of one operation can be included in one T1 or T2 declaration with the corresponding list of goods.

One means of transport is considered to be: a road vehicle together with a trailer(s) or semi-trailer(s); a train of railway vehicles or wagons coupled together; vessels forming a coupled group. Identification of goods is ensured by sealing. Under one transit declaration, one means of transport may transport cargo through the territories of all participating countries from the point of departure to the final destination.

Another advantage is the registration of one general financial guarantee. The Convention determines the calculation of its amount, in particular, the individual guarantee must cover the amount of debt that may arise, calculated on the basis of the highest rates of customs duties applicable to goods of the same type. Moreover, the guarantee can be provided in the following three forms: cash deposit; obligation provided by the guarantor; vouchers.

For air transport, a guarantee is not required if the goods are transported under the common transit procedure on the basis of an electronic transport document used as a transit declaration.

The technical basis for the implementation of the Convention is the NTCS technology (New Computerized Transit System), which connects customs services in the Convention countries, allowing the exchange of customs data. It is also called "customs visa-free". The competent authorities of the common transit countries are authorized to assume the functions of customs offices of departure, transit, destination and guarantee. The NTCS system allows the submission of a transit declaration to customs before the expected presentation of the goods, which provides a preliminary analysis of information about the cargo and possible risks. In the absence of risks, the procedure includes scanning the declaration barcode and checking the integrity of the seal. Such capabilities significantly speed up the time of crossing the borders.

Ukraine became the 36th country to join the Convention. Previously, the EU countries, the United Kingdom, the European Free Trade Association countries, Turkey, North Macedonia, and Serbia joined it.

In January 2025, Ukraine, like all countries participating in the Convention on the Common Transit Procedure, switched to the use of NCTS Phase 5, which provides for the use of electronic transit declarations EUCDM. Ukraine, as a candidate country for accession to the EU, has also implemented this new customs data model. Thanks to this, businesses can submit transit declarations to NCTS Phase 5 in one of three ways: 1) through the "Single Window"; 2) through the "Trader Portal"; 3) through broker software.

According to the State Customs Service of Ukraine, during 2025, almost 96.5 thousand movements initiated by the customs authorities of Ukraine were successfully completed in the countries-participants of the Convention. At the same time, more than 45.5 thousand movements initiated in other member states were successfully completed in Ukraine. The total number of transit declarations issued during 2025 was a record number in the framework of the international application of NCTS, compared to previous years, of about 142 thousand. It is also worth noting that the "customs visa-free" system is also actively used in internal transit. The number of such movements in 2025 was 24.5 thousand. Also, important indicators of the gradual transition to the European model of partnership between business structures and the customs authorities of Ukraine are the registered number and amount of financial guarantees. In particular, in 2025, 87 general guarantees were registered for a total amount of about 300 million euros and 22,701 individual guarantees for a total amount of over 1 billion euros [13].

The development of NCTS Phase 6 will be another important step for Ukraine towards integration with EU customs systems. Phase 6 aims to improve electronic customs procedures and ensure efficient transit of goods [14]. The transition to the Pan-European Import Control System (ICS2) and NCTS Phase 6 was planned by 1 September 2025, but at the request of Ukraine, the European Commission's Directorate-General for Taxation and Customs Union postponed the transition to 1 June 2026 [15].

Areas for further increasing the level of digitalization of customs services include expanding the base of authorized economic operators and integrating key types of control that must be carried out during international transportation (in particular, environmental, veterinary) into a single electronic platform.

At the same time, despite the high level of implementation of digital customs clearance, the speed of trade is constrained by the throughput capacity of checkpoints on the western border of Ukraine, where queues often form due to the limited number of terminals and blockages. Certain problems also remain with the transportation of goods by various modes of transport.

Compared to the traditional scheme of customs operations in multimodal transportation, when information is transmitted sequentially between customs offices, and a change in the mode of transport initiates a new cycle of customs and documentary formalities, accompanied by a high level of data duplication [16], the concept of a "single customs space" should be based on parallel data exchange, interoperability of systems and a single electronic environment. This involves the formation by the logistics operator of a Single Multimodal Electronic Document in the "Single Window" cloud system even before the shipment of the cargo, so that the artificial intelligence of the customs risk management system analyzes the entire multimodal route in advance, and in the case of low risk, the cargo is given the status of a "green corridor" for the entire multimodal chain. At the transshipment point, the goods are transshipped from one mode of transport to another automatically, without submitting new declarations. In this case, cargo identification should be ensured through electronic seals and Internet of Things tools, and the change of mode of transport should be recorded in the blockchain through the execution of smart contracts. Customs will be informed instantly via push notifications. Upon arrival of the cargo at the destination terminal, the electronic system should automatically close the delivery and release the goods, since all customs payments were blocked or paid at the initialization stage.

Therefore, the unification of customs operations when interacting with modes of transport in multimodal supply chains involves:

- obtaining AEO status by all participants in multimodal transportation, which will increase confidence in cargo and allow crossing customs borders without stopping for documentary control;
- introduction of a single electronic global multimodal transport document, which would be recognized by the customs of all countries;
- elimination of technological gaps in the levels of digitalization in various modes of transport, as well as integration of information systems of Ukrzaliznytsia, seaports and the State Customs Service;
- integration of databases of railway, sea, air and road carriers with the customs systems of compatible states;
- creation of "customs hubs" based on "dry ports", which requires the development of a network of modern multimodal terminals with customs control zones;
- elimination of duplication of control types during transshipment;
- implementation of artificial intelligence, blockchain and smart contract technologies for tracking cargo and recording changes in the mode of transport, as well as ensuring data security.

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Conclusions. An analysis of the current state of the organization and execution of customs procedures in Ukraine showed certain improvements in ensuring transparency in informing businesses, carrying out physical and administrative customs clearance, cooperation between customs and other regulatory authorities, implementation of such digital tools as: electronic submission of customs declarations, electronic payment of customs duties and taxes, use of the "Single Window" system. The introduction of the Authorized Economic Operator institute, accession to the Convention on the Common Transit Procedure, as well as the use of NTCS technology have become a significant step in the integration of Ukraine with the EU customs systems. Such measures have contributed to an increase in the number of successfully completed movements initiated by the customs authorities of Ukraine and initiated in other member states, the number and amount of financial guarantees. NTCS is also effectively used in internal transit.

At the same time, to unify customs procedures in multimodal logistics chains, it is necessary to ensure procedural and regulatory integration between interacting modes of transport (implementation of an electronic global transport document and obtaining end-to-end AEO status by all participants in the multimodal chain), create a single digital environment by combining databases of carriers and customs services using artificial intelligence, blockchain and smart contracts, as well as develop a network of multimodal terminals and "dry ports" with the functions of full-fledged customs hubs.

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